



TFT LCD Approval Specification

MODEL NO.: M236H3-P02

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REVISION HISTORY

Version	Date	Section	Description
Ver. 2.0	Nov.. 23, '09	-	M236H3-P02 Approval Specification was first issued.

1. GENERAL DESCRIPTION

1.1 OVERVIEW

The M236H3-P02 is a 23.6-inch wide TFT LCD open cell with driver ICs and a 30-pins-2ch-LVDS circuit board. The product supports 1920 x 1080 Full HD mode and can display up to 16.7M colors. The backlight unit is not built in.

1.2 FEATURES

- Super wide viewing angle
- High contrast ratio
- Fast response time
- High color saturation
- Full HDTV (1920 x 1080 pixels) resolution
- DE (Data Enable) only mode
- LVDS (Low Voltage Differential Signaling) interface
- RoHS Compliance

1.3 APPLICATION

- TFT LCD Monitor

1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Diagonal Size	23.547	inch	-
Active Area	521.28 (H) x 293.22 (V)	mm	(1)
Driver Element	a-Si TFT active matrix	-	-
Pixel Number	1920 x R.G.B. x 1080	pixel	-
Pixel Pitch	0.2715 (H) x 0.2715 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	16.7M	color	-
Transmissive Mode	Normally White	-	-
Surface Treatment	Hard coating (3H), Anti-glare (Haze 25%)	-	-
Power Consumption	5.5	Watt	(3)

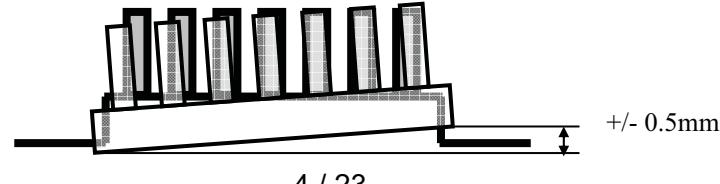
1.5 MECHANICAL SPECIFICATIONS

Item	Min.	Typ.	Max.	Unit	Note
Weight	-	-	710	g	-
I/F connector mounting position	The mounting inclination of the connector makes the screen center within $\pm 0.5\text{mm}$ as the horizontal.			-	(2)

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

(2) Connector mounting position

(3) Please refer to sec.3.1 for more information of power consumption.



2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT (BASED ON CMO MODULE M236H3-L02)

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T_{ST}	-20	+60	°C	(1)
Operating Ambient Temperature	T_{OP}	0	+50	°C	(1), (2)

3. ELECTRICAL CHARACTERISTICS

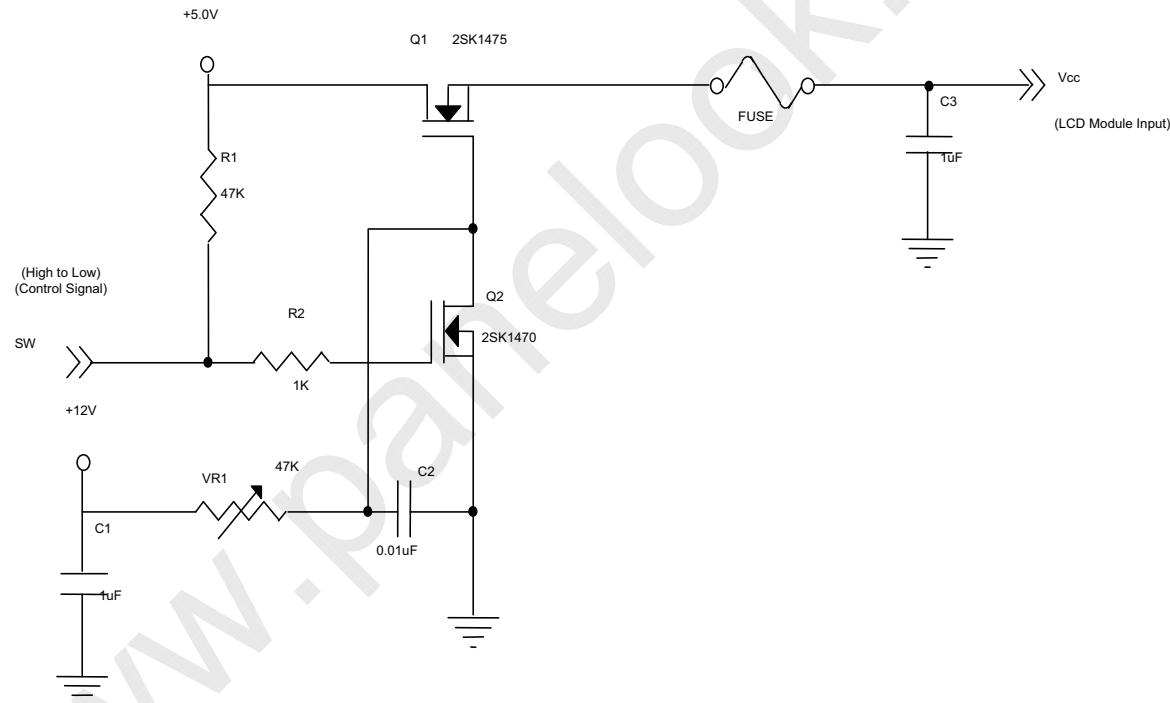
3.1 TFT LCD OPEN CELL

$T_a = 25 \pm 2 ^\circ\text{C}$

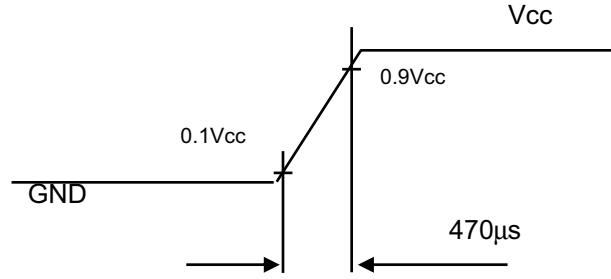
Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	V _{CC}	4.5	5.0	5.5	V	-
Ripple Voltage	V _{RP}	-	-	300	mV	-
Power On Rush Current	I _{RUSH}	-	-	3	A	(2)
Power Supply Current	White	-	0.5	0.6	A	(3)
	Black	-	1.1	1.32	A	(3)
	Vertical Stripe	-	0.9	1.08	A	(3)
Power Consumption	P _{LCD}	-	5.5	6.6	Watt	(4)
LVDS differential input voltage	V _{ID}	100	-	600	mV	-
LVDS common input voltage	V _{IC}	1.0	1.2	1.4	V	-
Logic High Input Voltage	V _{IH}	2.64	-	3.6	V	-
Logic Low Input Voltage	V _{IL}	0	-	0.66	V	-

Note (1) The product should be always operated within above ranges.

Note (2) Measurement Conditions:



V_{CC} rising time is 470μs



Note (3) The specified power supply current is under the conditions at $V_{cc} = 5.0$ V, $T_a = 25 \pm 2$ °C, $F_v = 60$ Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern



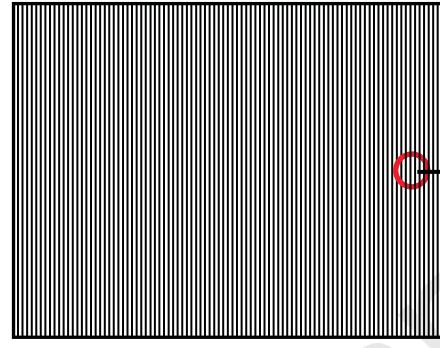
Active Area

b. Black Pattern

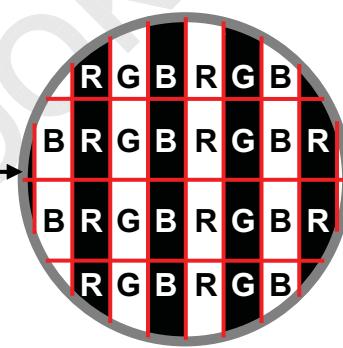


Active Area

c. Vertical Stripe Pattern

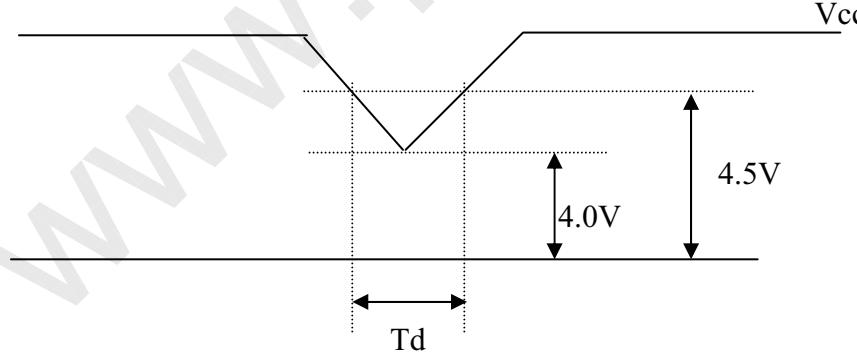


Active Area



Note (4) The power consumption is specified at the pattern with the maximum current.

3.2 V_{cc} Power Dip Condition:

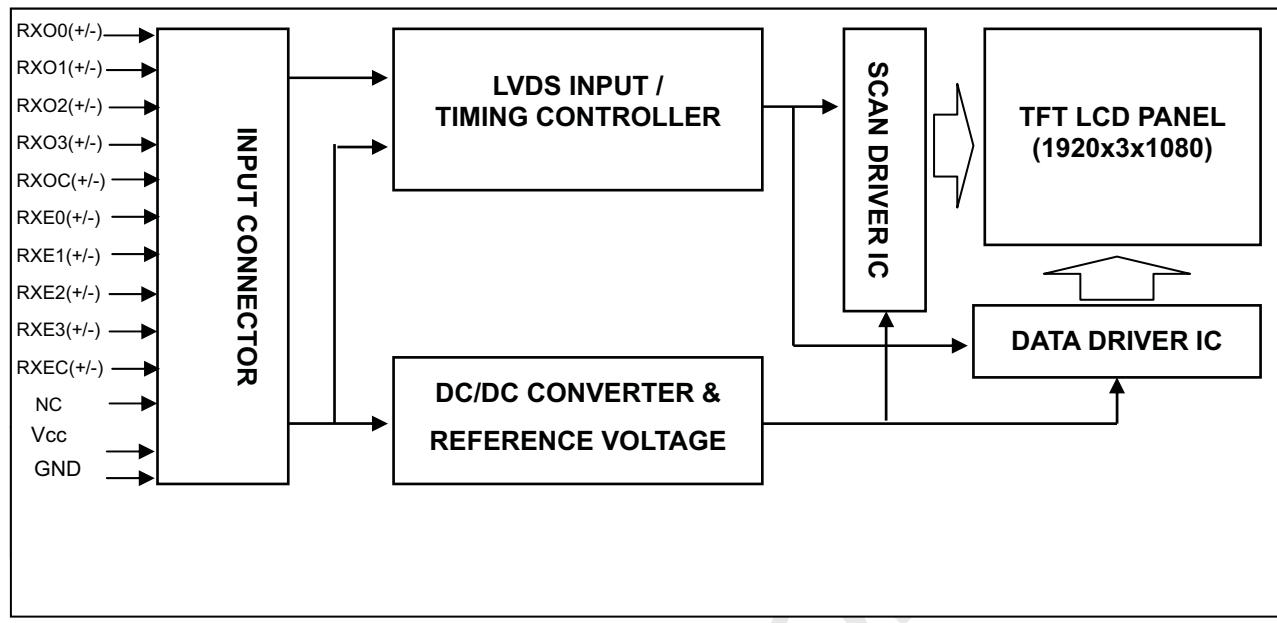


Dip condition: $4.0V \leq V_{cc} \leq 4.5V$, $T_d \leq 20ms$



4. BLOCK DIAGRAM

4.1 TFT LCD OPEN CELL



5. INPUT TERMINAL PIN ASSIGNMENT

5.1 TFT LCD MODULE

Pin	Name	Description
1	RXO0-	Negative LVDS differential data input. Channel O0 (odd)
2	RXO0+	Positive LVDS differential data input. Channel O0 (odd)
3	RXO1-	Negative LVDS differential data input. Channel O1 (odd)
4	RXO1+	Positive LVDS differential data input. Channel O1 (odd)
5	RXO2-	Negative LVDS differential data input. Channel O2 (odd)
6	RXO2+	Positive LVDS differential data input. Channel O2 (odd)
7	GND	Ground
8	RXOC-	Negative LVDS differential clock input. (odd)
9	RXOC+	Positive LVDS differential clock input. (odd)
10	RXO3-	Negative LVDS differential data input. Channel O3(odd)
11	RXO3+	Positive LVDS differential data input. Channel O3 (odd)
12	RXE0-	Negative LVDS differential data input. Channel E0 (even)
13	RXE0+	Positive LVDS differential data input. Channel E0 (even)
14	GND	Ground
15	RXE1-	Negative LVDS differential data input. Channel E1 (even)
16	RXE1+	Positive LVDS differential data input. Channel E1 (even)
17	GND	Ground
18	RXE2-	Negative LVDS differential data input. Channel E2 (even)
19	RXE2+	Positive LVDS differential data input. Channel E2 (even)
20	RXEC-	Negative LVDS differential clock input. (even)
21	RXEC+	Positive LVDS differential clock input. (even)
22	RXE3-	Negative LVDS differential data input. Channel E3 (even)
23	RXE3+	Positive LVDS differential data input. Channel E3 (even)
24	GND	Ground
25	NC	Not connection, this pin should be open.
26	NC	Not connection, this pin should be open.
27	NC	Not connection, this pin should be open.
28	Vcc	+5.0V power supply
29	Vcc	+5.0V power supply
30	Vcc	+5.0V power supply

Note (1) Connector Part No.: STM MSCKT2407P30HA or Starconn 093G30-B2001A

Note (2) The first pixel is odd.

Note (3) Input signal of even and odd clock should be the same timing.

5.2 LVDS DATA MAPPING TABLE

LVDS Channel O0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	OG0	OR5	OR4	OR3	OR2	OR1	OR0
LVDS Channel O1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	OB1	OB0	OG5	OG4	OG3	OG2	OG1
LVDS Channel O2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	OB5	OB4	OB3	OB2
LVDS Channel O3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	OB7	OB6	OG7	OG6	OR7	OR6
LVDS Channel E0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	EG0	ER5	ER4	ER3	ER2	ER1	ER0
LVDS Channel E1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	EB1	EB0	EG5	EG4	EG3	EG2	EG1
LVDS Channel E2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	EB5	EB4	EB3	EB2
LVDS Channel E3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	EB7	EB6	EG7	EG6	ER7	ER6

5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																							
		Red								Green								Blue							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	Red(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Red(253)	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(254)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Green	Green(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Green(253)	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0
	Green(254)	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale Of Blue	Blue(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Note (1) 0: Low Level Voltage, 1: High Level Voltage

6. INTERFACE TIMING

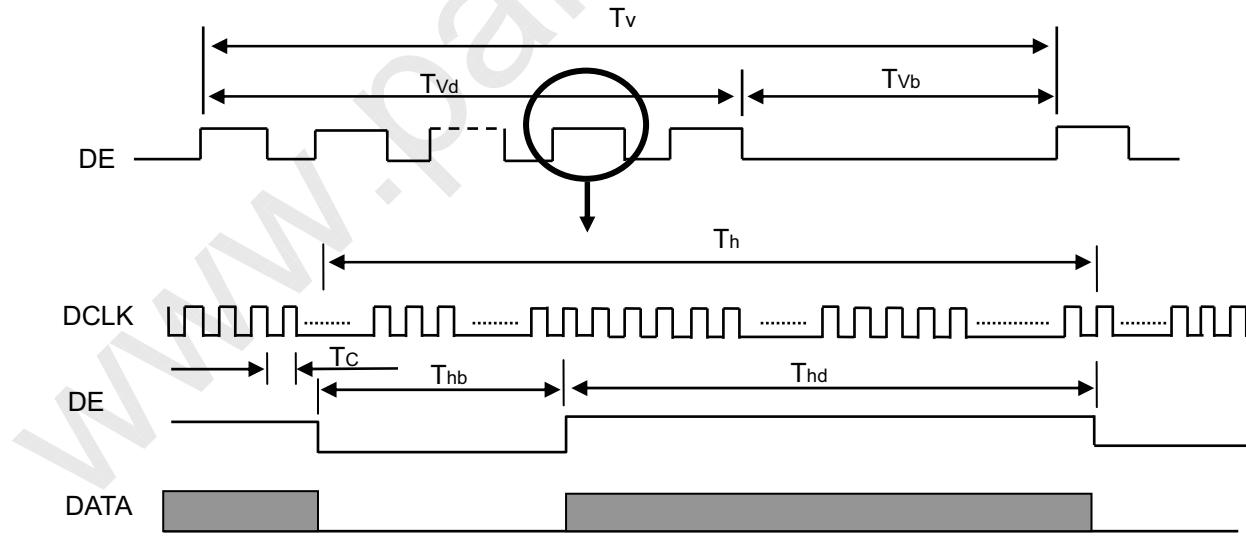
6.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

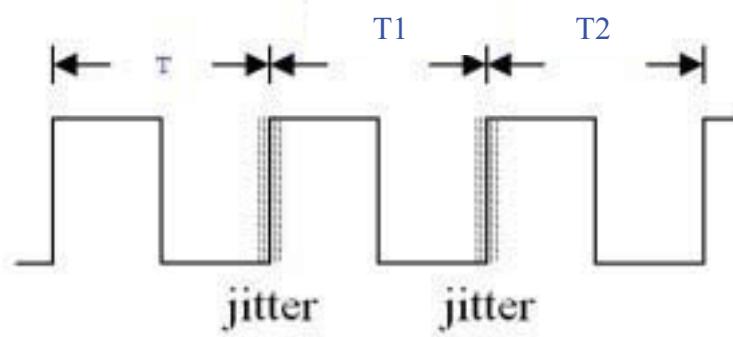
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F_c	58.54	74.25	98	MHz	-
	Period	T_c	-	13.47	-	ns	-
	Input cycle to cycle jitter	T_{rcl}	-0.02*Tc	-	0.02*Tc	ns	(1)
	Spread spectrum modulation range	F_{clock_mod}	0.98*Fc	-	1.02*Fc	MHz	(2)
	Spread spectrum modulation frequency	F_{SSM}	-	-	200	KHz	
	High Time	T_{ch}	-	4/7	-	T_c	-
LVDS Data	Low Time	T_{cl}	-	3/7	-	T_c	-
	Setup Time	T_{lvs}	600	-	-	ps	(3)
Vertical Active Display Term	Hold Time	T_{lvh}	600	-	-	ps	
	Frame Rate	Fr	50	60	75	Hz	$T_v=T_{vd}+T_{vb}$
	Total	T_v	1115	1125	1136	Th	-
	Display	T_{vd}	1080	1080	1080	Th	-
Horizontal Active Display Term	Blank	T_{vb}	35	45	56	Th	-
	Total	T_h	1050	1100	1150	T_c	$T_h=T_{hd}+T_{hb}$
	Display	T_{hd}	960	960	960	T_c	-
	Blank	T_{hb}	90	140	190	T_c	-

Note: Because this module is operated by DE only mode, Hsync and Vsync input signals are ignored.

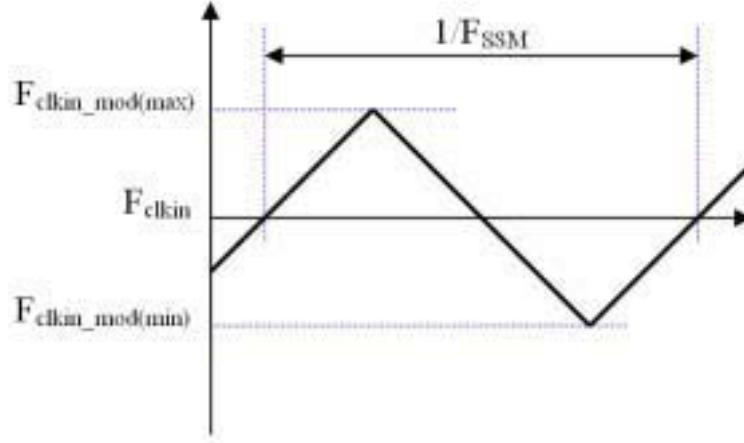
INPUT SIGNAL TIMING DIAGRAM



Note (1) The input clock cycle-to-cycle jitter is defined as below figures. $T_{ccl} = |T_1 - T_2|$

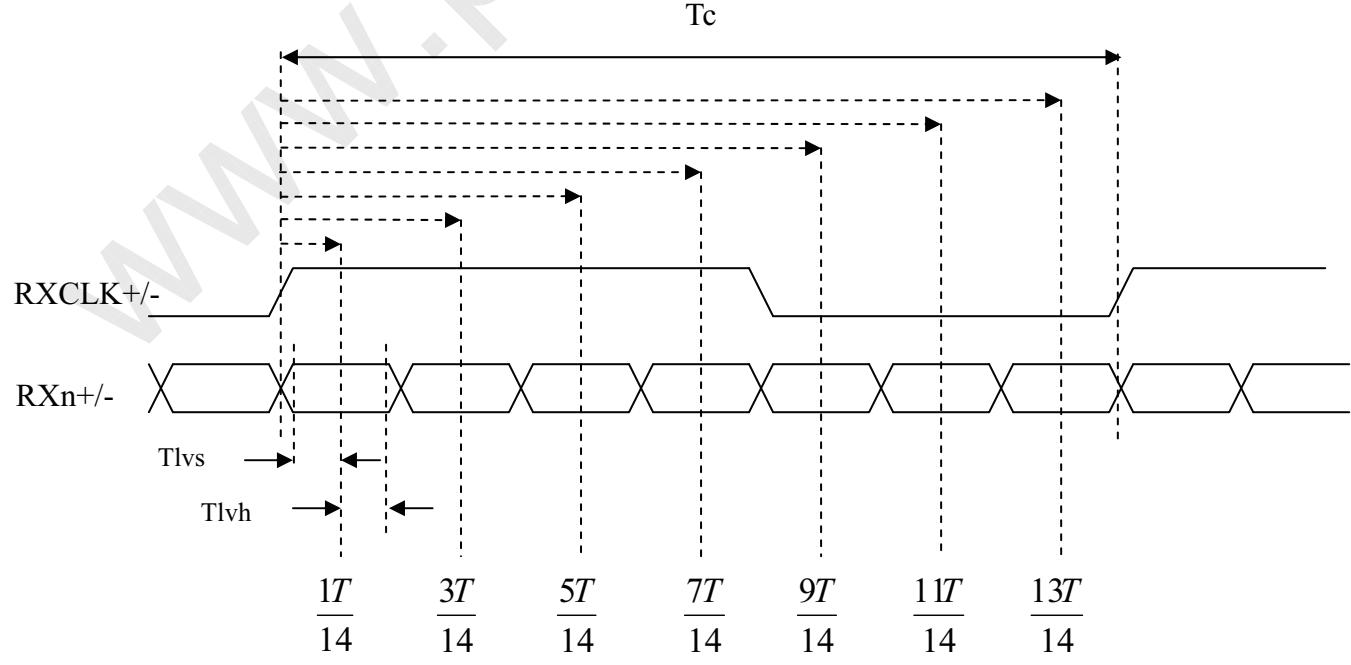


Note (2) The SSCG (Spread spectrum clock generator) is defined as below figures.



Note (3) The LVDS timing diagram and setup/hold time is defined and showing as the following figures.

LVDS RECEIVER INTERFACE TIMING DIAGRAM



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7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	T _a	25 ± 2	°C
Ambient Humidity	H _a	50 ± 10	%RH
Supply Voltage	V _{CC}	7.0	V
Input Signal		According to typical value in "3. ELECTRICAL CHARACTERISTICS"	
Inverter Current	I _L	7.0 ± 0.5	mA
Inverter Driving Frequency	F _L	55 ± 5	KHz

7.2 OPTICAL SPECIFICATIONS

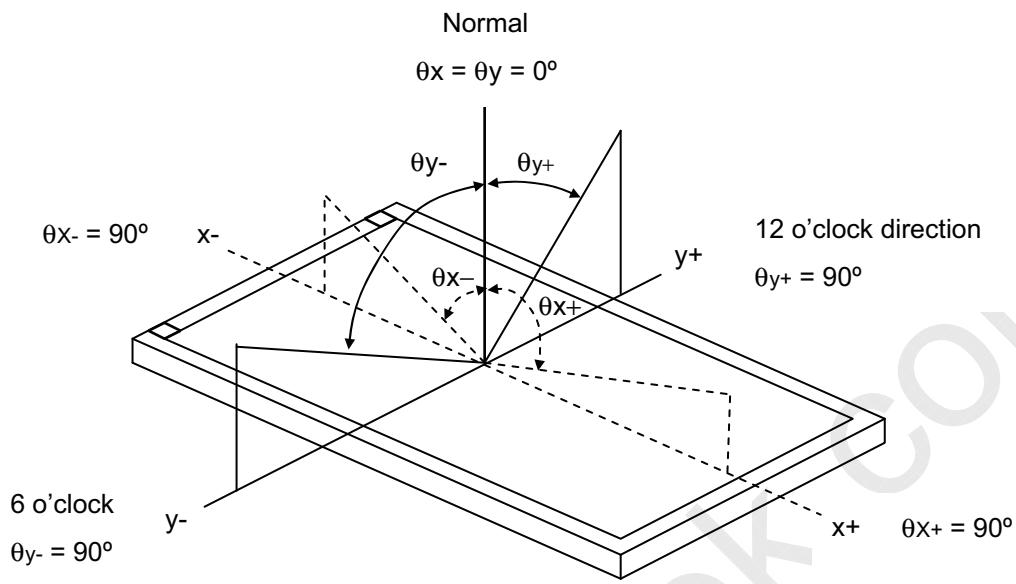
The relative measurement methods of optical characteristics are shown as below. The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (6) & (7).

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note		
Color Chromaticity (CIE 1931)	Red	θ _x =0°, θ _y =0° Standard light source "C" (Measured by DMS 803)	Typ - 0.03	0.648	Typ + 0.03	-	(0),(1), (7)		
				0.327		-			
	Green			0.270		-			
				0.584		-			
	Blue			0.148	0.03	-			
				0.106		-			
	White			0.323		-			
				0.359		-			
Center Transmittance	DBEFD	θ _x =0°, θ _y =0° CS-2000, CMO BLU	9.8	11.6	-	%	(1), (5)		
	Diffuser		5.1	6.1	-	%	(1), (5)		
Contrast Ratio			700	1000	-	-	(1), (3)		
Response Time		θ _x =0°, θ _y =0°	-	1.5	2.5	ms	(4)		
			-	3.5	5.5	ms			
Transmittance uniformity		θ _x =0°, θ _y =0° USB2000	-	-	1.33	-	(1), (8)		
Viewing Angle	Horizontal	θ _x ⁺ +θ _x ⁻	CR≥10	150	170	-	Deg. (2), (6)		
	Vertical	θ _y ⁺ +θ _y ⁻		140	160	-			

Note (0) Light source is the standard light source "C" which is defined by CIE and driving voltages are based on suitable gamma voltages.

Note (1) Light source is the BLU which is supplied by CMO and driving voltages are based on suitable gamma voltages. White is without signal input and R, G, B are with signal input. SPEC is judged by CMO's golden sample.

Note (2) Definition of Viewing Angle (θ_x, θ_y):



Note (3) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

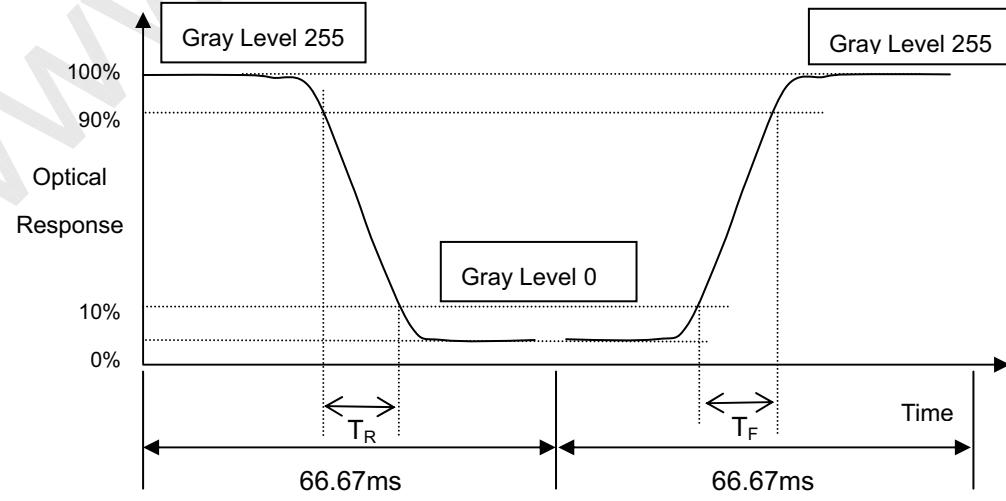
L_{255} : Luminance of gray level 255

L_0 : Luminance of gray level 0

$$CR = CR (5)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (8).

Note (4) Definition of Response Time (T_R, T_F):



Note (5) Definition of Transmittance (T%):

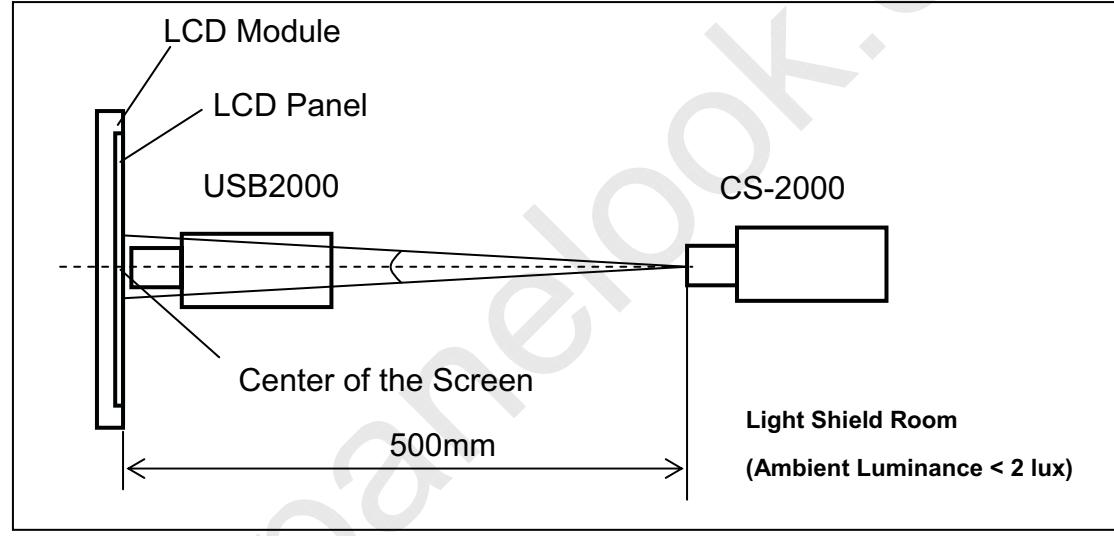
Module is without signal input.

$$\text{Transmittance} = \frac{\text{Luminance of LCD module } L(5)}{\text{Luminance of backlight } L_{BLU}(5)} \times 100\%$$

$L(x)$ and $L_{BLU}(X)$ are corresponding to the luminance of the point X at Figure in Note (8).

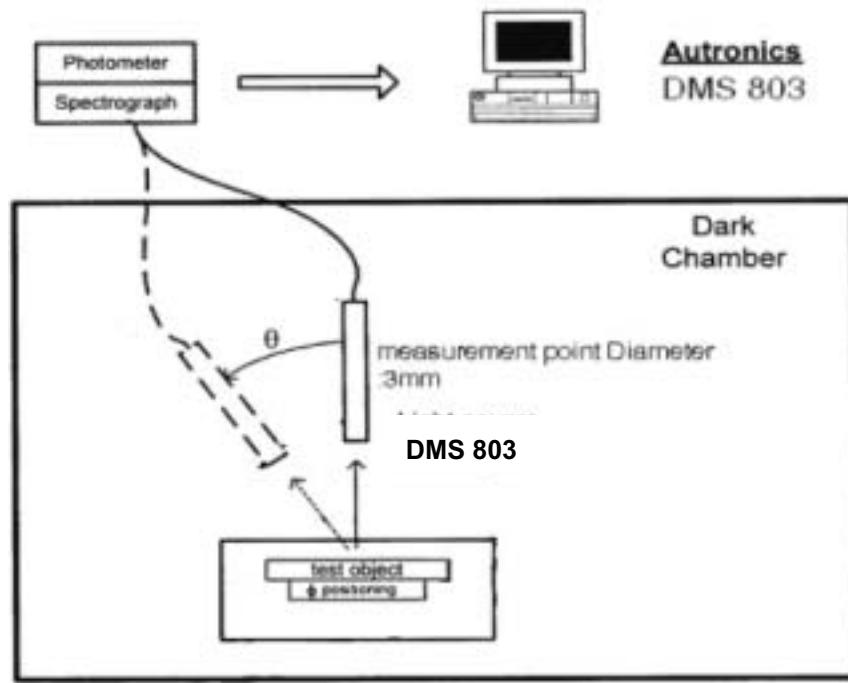
Note (6) Measurement Setup:

The LCD module should be stabilized at given temperature for 40 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 40 minutes in a windless room.



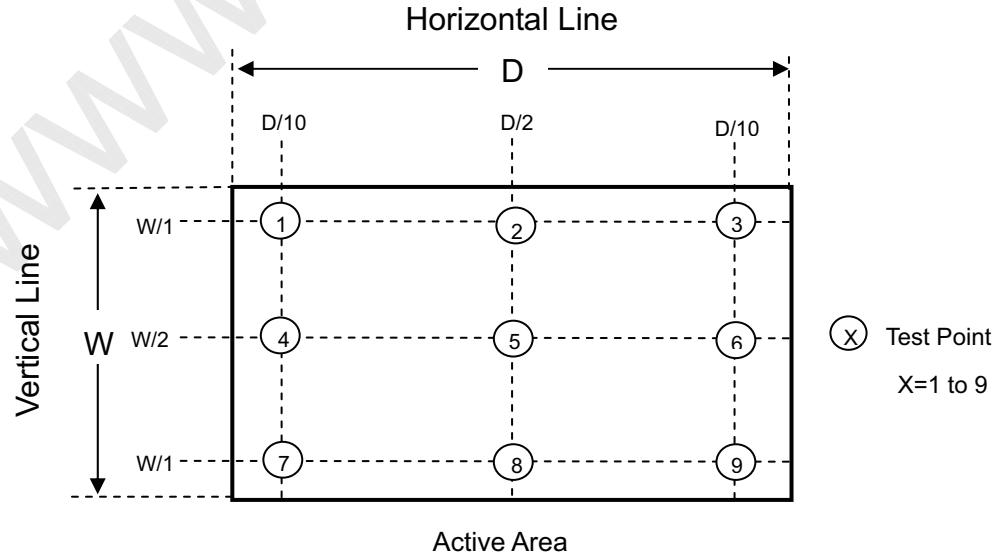
Note (7) Measurement Setup:

The LCD Panel should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after light source "C" for 30 minutes in a windless room.

**Note (8) Definition of Transmittance Variation ($\delta T\%$):**

Measure the transmittance at 9 points.

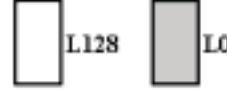
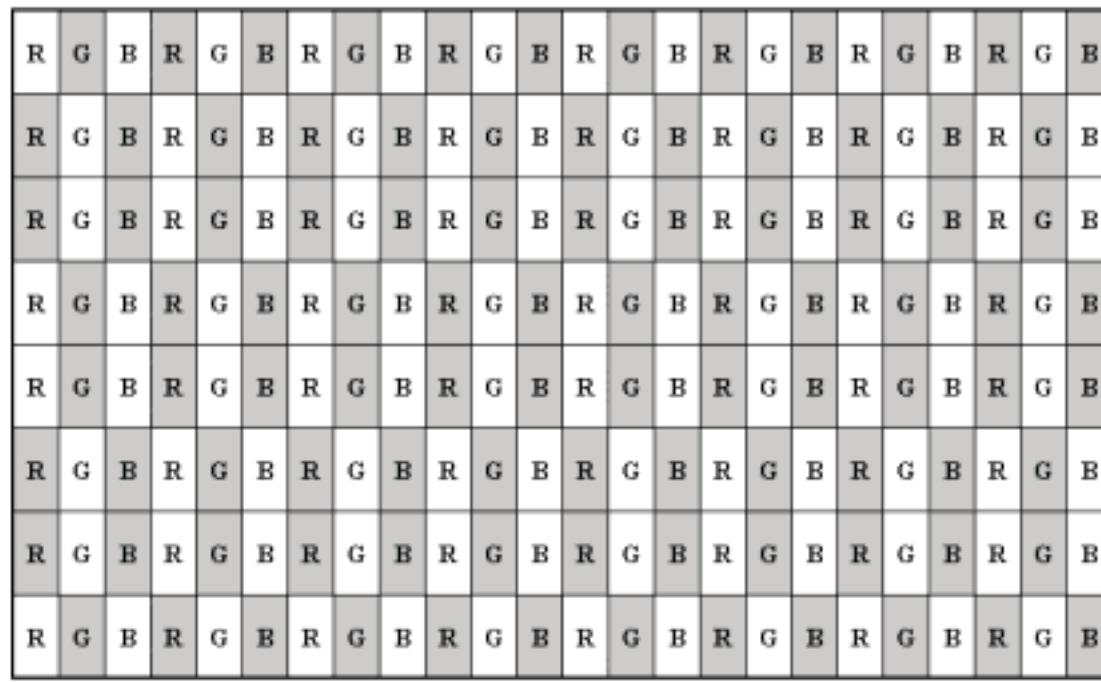
$$\delta T\% = \frac{\text{Maximum } [L(1), L(2), \dots, L(8), L(9)]}{\text{Minimum } [L(1), L(2), \dots, L(8), L(9)]}$$



7.3 Flicker Adjustment

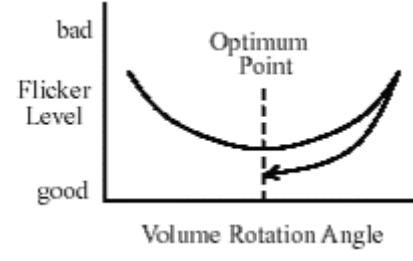
Flicker must be finely adjusted after module assembling and aging. Please follow the instructions below.

(1) Adjustment Pattern: 2H1V checker pattern as follows.



(2) Adjustment Method:

Flicker should be adjusted by turning the volume for flicker adjustment by the ceramic driver. It is adjusted to the point with least flickering of the whole screen. After making it surely overrun at once, it should be adjusted to the optimum point.





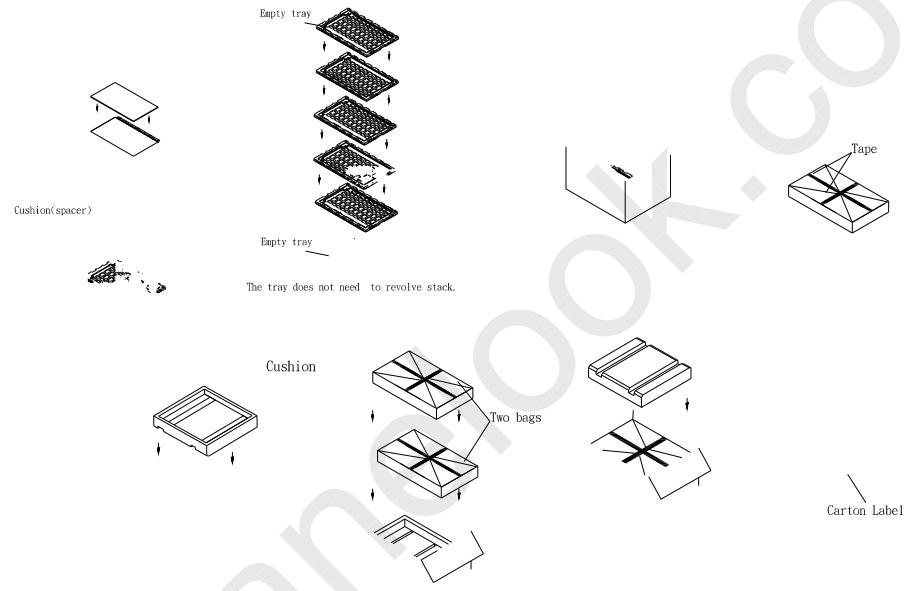
8. PACKAGING

8.1 PACKING SPECIFICATIONS

- (1) 24 open cells / 1 Box
- (2) Box dimensions : 670(L)x575(W)x325(H)mm
- (3) Weight: approximately 24Kg (24 open cells per box)

8.2 PACKING METHOD

Figures 8-1 and 8-2 are the packing methods.



9. DEFINITION OF LABELS

9.1 CMO OPEN CELL LABEL

The barcode nameplate is pasted on each OPEN CELL as illustration for CMO internal control.



Barcode definition:

Serial ID: CM-23H32-X-X-X-XX-L-XX-L-YMD-NNNN

Code	Meaning	Description
CM	Supplier code	CMO=CM
23H32	Model number	M236H3-P02=23H32
X	Revision code	C1:1, C2:2.....
X	Source driver IC code	Century=1, CLL=2, Demos=3, Epson=4, Fujitsu=5, Himax=6, Hitachi=7, Hynix=8, LDI=9, Matsushita=A, NEC=B, Novatec=C, OKI=D, Philips=E, Renasas=F, Samsung=G, Sanyo=H, Sharp=I, TI=J, Topro=K, Toshiba=L, Windbond=M
XX	Cell location	Tainan, Taiwan=TN
L	Cell line #	1,2,~,9,A,B,~,Y,Z
XX	Module location	Tainan, Taiwan=TN ; Ningbo China=NP
L	Module line #	1,2,~,9,A,B,~,Y,Z
YMD	Year, month, day	Year: 2001=1, 2002=2, 2003=3, 2004=4... Month: 1~12=1, 2, 3, ~, 9, A, B, C Day: 1~31= 1, 2, 3, ~, 9, A, B, C, ~, T, U, V
NNNN	Serial number	Manufacturing sequence of product

9.2 CARTON LABEL



The barcode nameplate is pasted on each box as illustration, and its definitions are as following explanation.

- (a) Model Name: M236H3-P02
- (b) Carton ID: CMO internal control
- (c) Quantities: 24 pcs



10. RELIABILITY TEST

Environment test conditions are listed as following table.

Items	Required Condition	Note
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11. PRECAUTIONS

11.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) Do not apply rough force such as bending or twisting to the product during assembly.
- (2) To assemble or install module into user's system can be only in clean working areas. Dust and oil may cause electrical short or worsen the polarizer.
- (3) It is not permitted to have pressure or impulse on the product because the LCD panel will be damaged.
- (4) Always follow the correct power sequence when the product is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
- (5) Do not pull I / F connector in or out while the module is operating.
- (6) Use a soft dry cloth without chemicals for cleaning because the surface of polarizer is very soft and easily scratched.
- (7) It is dangerous that moisture comes into or contacts the product because moisture may damage the product when it is operating.
- (8) High temperature or humidity may reduce the performance of module. Please store this product within the specified storage conditions.
- (9) When ambient temperature is lower than 10°C, it may reduce display quality. For example, the response time will become slow.

11.2 SAFETY PRECAUTIONS

- (1) If the liquid crystal material leaks from the panel, it should be kept away from eyes or mouth. In case of contacting with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (2) After the product's end of life, it is not harmful in case of normal operation and storage.

11.3 OTHER

- (1) When fixed patterns are displayed for a long time, remnant image is likely to occur.

12. MECHANICAL DRAWING

